DOCUMENT RESUME

ED 337 147 IR 015 198

AUTHOR Wilson, Kathleen; Tally, William
TITLE Designing for Discovery: Interactive Multimedia Learning Environments at Bank Street College. Technical Report No. 15.
INSTITUTION Center for Technology in Education, New York, NY.
PUB DATE Jul 91
NOTE 22p.; For related reports, see IR 015 197 and IR 015 200.
PUB TYPE Viewpoints (Opinion/Position Papers, Essays, etc.) (120) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Child Development; Computer Assisted Instruction; Discovery Learning; *Educational Environment; Educational Television; Electronic Classrooms; Elementary Education; Formative Evaluation; *Instructional Design; Instructional Materials; *Interaction; Interactive Video; Interviews; *Learning Theories; Material Development; Models; *Multimedia Instruction; Teacher Student Relationship

ABSTRACT

This report discusses "multimedia" instruction as it applies to successful learning environments at Bank Street College of Education (New York), ranging from pre-electronic to electronic. In four of the interviews detailed, a Bank Street College professor, researcher, and two Bank Street School for Children teachers offer different perspectives for thinking about the character and quality of the learning situation, the nature of learning materials, the structure of the learning environment, the kinds of interactions that are built into those environments, and the theories of learning and child development implicit in their work. In the last three interviews, other Bank Street staff respond to the need for a variety of design models for electronic multimedia environments. Two models are discussed which exemplify the Bank Street tradition in multimedia design: "The Voyage of the Mimi," a television series, and the videodisk-based "Palenque." The role of formative evaluation in the development of these multimedia materials is also discussed in an interview with a formative researcher who worked on both projects, and the relationship between teacher and student in a multimedia classroom is considered. A list of 88 related articles is provided. (Author/DB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED 382 718

CENTER FOR TECHNOLOGY IN EDUCATION

Designing for Discovery: Interactive Multimedia Learning Environments at Bank Street College

Kathleen Wilson & William Tally

Bank Street College of Education

BANK STREET COLLEGE OF EDUCATION
610 WEST 112th STREET
NEW YORK, NY 10025

120151 98

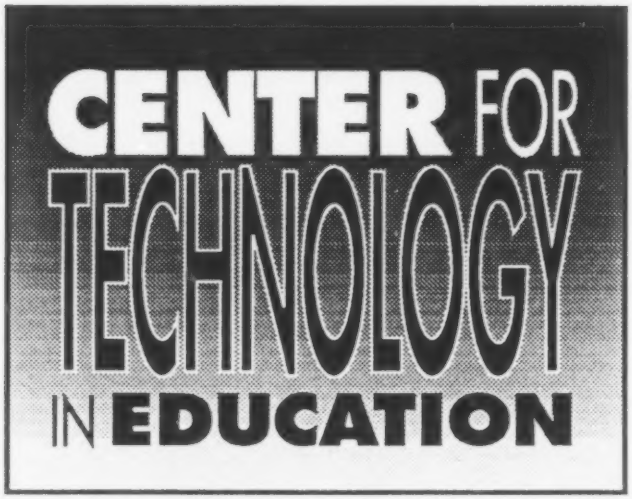
"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

K. McMillan

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

Technical
Report
Series



Technical Report No. 15

Designing for Discovery: Interactive Multimedia Learning Environments at Bank Street College

Kathleen Wilson & William Tally

Bank Street College of Education

July 1991

Tech. Rep. No. 15

DESIGNING FOR DISCOVERY: Interactive Multimedia Learning Environments at Bank Street College

Kathleen Wilson and William Tally
Bank Street College of Education

This report is an effort to discuss a broadly-defined word—"multimedia"—through a narrow focus, as it applies to successful learning environments at Bank Street College, ranging from pre-electronic to electronic. In four of the following interviews, Bank Street professionals reflect on the development of nonelectronic multimedia educational materials and environments at Bank Street. A Bank Street College professor, researcher, and two Bank Street School for Children teachers offer different perspectives for thinking about the character and quality of the learning situation, the nature of learning materials, the structure of the learning environment, the kinds of interactions that are built into those environments, and the theory of learning and child development implicit in their work. In the last three interviews, other Bank Street staff respond to the need for a variety of design models for electronic multimedia environments. Two models are discussed which exemplify the Bank Street tradition in multimedia design: The Voyage of the Mimi *and* Palenque. *The role of formative research in the development of these multimedia materials is also discussed in an interview with a formative researcher who worked on both projects.*

INTRODUCTION

The term "multimedia" has become increasingly widespread in professional circles, ranging from educational computing to corporate desktop computing, but it has yet to be precisely defined or used in a standardized way. Discussion often focuses on the value of rich, multimedia applications as environments for learning; in this context, definitions of multimedia are often computer-based. Yet the term multimedia is not new, and predates the computer era. In the corporate world, for example, multimedia has been used in the past in reference to multi-projector slide shows for all kinds of presentations, often with sophisticated graphics, slides, dissolves, and accompanying sound tracks. Multimedia has also long been a feature of educational life, even while it was not known by this term. Teachers and students in the typical preschool classroom, for example, are surrounded by multitudes of materials—blocks, paints, clay, musical instruments, costumes, animals, plants and, more recently, computers. Children often work in miniworlds or activity centers within the classroom, each of which may involve different types of teachers, materials, machines, activities, or instruction. Teachers at all grade levels and content areas have incorporated this kind of approach.

In this report, Bank Street professionals reflect on the development of nonelectronic multimedia educational materials and environments at Bank Street, and

the need for a variety of design models for electronic multimedia environments. Each interview offers a different perspective on the character and quality of the learning situation, the nature of learning materials, the structure of the learning environment, the kinds of interactions that are built into different materials, and the theory of learning and child development that supports their perspective.

What is there to be learned from the history of multimedia educational environments, both electronic and nonelectronic? Early educational multimedia applications, often nurtured in corporate and military training settings, tended to reflect a lack of contact with what went on in school classrooms, as well as traditions of educational research and materials development that have long helped shape classroom practice. While theories and approaches differ, teachers, researchers, and educational materials developers agree on at least one thing: Learning is not a matter of opening up kids' heads and pouring in information in the most efficient way possible. Even a cursory look at any classroom offers evidence that learning is associational (proceeding on the basis of the student's prior experience, ability, and interests), and that it is a collaborative activity, deeply embedded in a network of social and emotional relationships. It is our belief that multimedia design in education can benefit from the experience of teachers in successful classrooms and from the experience of researchers and developers of nonelectronic educational materials. One particular tradition of educational theory and practice, embodied in the following interviews, has evolved at Bank Street.

These interviews, with educators who are each, in their own way, deeply committed to Bank Street's educational traditions, offer alternative perspectives for thinking about the ingredients of a successful learning experience. We hope these perspectives will be useful to people concerned with the design of electronic media for education and, particularly, multimedia in education. Four questions, or categories of thinking, are raised by these interviews that complement traditional concerns for efficiency and standardization in educational design: (1) What *materials* are at the core of the learning experience? (2) How is the *environment* in which the learning takes place organized? (3) What kinds of *interactions* are encouraged between the human agents involved in the learning transaction? (4) What underlying *theory* or pedagogy guides decisions about educational goals and the methods used to achieve them?

Our central concern in this paper is to explore the possibility of translating the ideas and biases that characterize Bank Street work into new electronic media. Each of these interviews articulates a unique interpretation of the Bank Street approach, and a different approach to the relationship between materials, students, teachers, and pedagogical theory.

- **Harriet Cuffaro's** work on young children's play with blocks argues that we should be sensitive to the roles that different kinds of materials can play in children's intellectual and emotional development.
- The organization of **George Burns'** classroom illustrates how a well-designed learning environment can support not only intellectual work, but also such things as individuality and community feeling.
- **Rosemarie Buzzio's** approach to teaching science and math foregrounds a particular type of interaction between student and teacher (and student and materials), which is critical, questioning, and oriented towards helping each student come to an understanding for him- or herself.
- **Edna Shapiro's** long experience as a developmental psychologist and researcher has given her a deep familiarity with the theoretical ideas that have helped shape educational practice at Bank Street since its founding.
- **Sam Gibbon**, the executive producer of Bank Street's *The Voyage of the Mimi* television series and curriculum materials, discusses his pioneering integration of existing media to make classroom learning in science and math more vivid and more meaningfully related to real-world pursuits.
- **Kathy Wilson**, director/designer of The Palenque Project, reflects on the different interpretations of multimedia that are represented in her award-winning digital video interactive prototype for children, *Palenque*.
- **Bill Tally**, who conducted formative research for both of the above media design efforts, discusses the role that research with children can play in the development of multimedia environments.

Much of our current research and development work at Bank Street is concerned with creating multimedia learning environments that incorporate new resources and media. But rather than moving forward as a completely new, unrelated, and ahistorical activity, this design and development process attempts to

build on, learn from, and complement earlier work at Bank Street by maintaining the major pedagogical ideas inherent in pre-electronic educational methods and materials. We believe multimedia environments can serve both to model particular kinds of learning interactions, and play supportive roles in larger efforts to reform and restructure classrooms and schools. Our hope is that all of these learning environments, electronic or not, offer media designers a wider set of terms for thinking about the ingredients of successful learning experiences for children.

Edna Shapiro: The Theory and History of the "Bank Street Approach"

We talked to Edna Shapiro, for over thirty years a developmental psychologist in Bank Street's Research Division, in order to trace the outlines of the theory and history behind the Bank Street approach.

This dialectic of experience and education appears in the work of Lucy Sprague Mitchell, Bank Street's founder. In discussing the foundations of environmental education in her pioneering work *Young Geographers* (1934), she writes:

> The classroom is always regarded as a sort of studio-laboratory which is provided with materials which serve the children in reliving their first-hand experiences (e.g., of their neighborhood), in working out the relationships in various source materials, and in free expression through various media. (p. 26).

Where in the developmental sequence do electronic media enter, and what roles can they play? Edna differs from some of her colleagues (including Harriet Cuffaro) by leaving these questions open for empirical investigation. Electronic environments should not be rejected as betrayals of "direct experience" even for young children, she believes, since, after all, they form a large part of children's everyday experiences in a media-dominated culture. "Experience is where you find it," she says. For our purposes as designers, we might take this as a cue to think about ways interactive multimedia might be used to help children reflect on their experience of our media culture, including, for example, television, news, films, and advertising.

The Interview

Q: Is there such a thing as the Bank Street approach?

In the 1970s I wrote a paper on the Bank Street philosophy. In the course of writing the paper, the term "developmental interaction" was developed to describe the Bank Street approach. This new term was created as an alternative to the "Bank Street approach" because the approach is used in many places, not just Bank Street. The term was designed to try to capture the idea that thinking about development and how it occurs is a crucial part of this learning philosophy, in addition to the importance of having a variety of interactions in learning environments, such as those between child and child, child and teacher, and child and materials.

Q: Can you trace briefly the origins of developmental interaction?

Historically, there are several sources. Dewey's ideas about learning by doing, the importance of the learning environment, the importance of the social nature of the world, and the fact that school should be a democratic model are all central. There are also people like Susan Isaacs (1930s, England) who was part of the psychoanalytic tradition, who had an influence. In keeping with Isaac's ideas, school was seen as a place for children to express their emotional concerns, as well as a place to learn. In this kind of school, children could work out their conflicts from home. Piaget's ideas had less of an influence. The work of Piaget at that time was primarily in the areas of language, thought, and moral development, which is quite different from his later cognitive emphasis.

The rhetoric of the early days of the Bank Street philosophy focused on the social and emotional development of the child. Any concern for cognitive development was not as explicit. School was seen as a less tense, less charged arena than the home, and therefore a place to work through various emotional conflicts. In the early days at Bank Street, physical development was also of great interest. The whole area of child studies was quite new.

It must be said that in the beginning Bank Street's expertise was based on work with middle-class, relatively privileged children. In New York City, there were several experimental schools, such as the Little Red School House, the City and Country School, and the Walden School, that kept in touch with each other. There was an effort in the 1930s to train public school teachers in the methods used by the teachers in these experimental schools. Later, during World War II, with the growth of day care, the needs of public school children came more to the fore.

Q: How are some of the ideas inherent in the Bank Street philosophy translated into the classroom context?

There are several things. One is that there has always been a lot of attention paid to the physical environment

of the classroom. Another basic idea has to do with having respect for children. A third idea is that the teacher is someone the child can trust, an authority who is rational. In other words, the teacher does not say "do as I say because I said so," but tries to explain why it's important to do some things and not other things.

There is a lot of emphasis in a typical Bank Street classroom on materials. In the early days, Carolyn Pratt invented the unit block and wedgy people. A classroom full of materials is thought to provide lots of different ways for children to express themselves, to make experiences theirs—to play things out, build them out, draw them out, etc. With a range of materials, the hope is that each child will find something suitable for him. Also, having a range of materials available might be useful to express things in different ways or to express different aspects of an experience.

Q: What is discovery-based learning?

There's a quote from Piaget that is something like, "every time we teach something to a child, we're depriving that child of the opportunity to discover for himself." I don't really think you can let a child discover everything for himself. Our culture helps save us from having to literally discover everything. The idea of discovery-based learning can be contrasted to the idea of the child as a passive receptacle.

I don't want to imply that the early Bank Street teachers and researchers explicitly incorporated some of Vygotsky's ideas, but his concept of the zone of proximal development is implicit in the Bank Street philosophy. This is, quite simplistically, the idea of finding out where the child is and helping him go to the next step.

Discovery learning has a lot to do with preparing the environment, having the materials available, and providing opportunities that make growth possible. There has been a lot of discussion about the use of structured vs. unstructured materials. For example, blocks used to build your own trains and tracks could be thought of as unstructured, pre-made, but discrete railroad tracks and cars from which you build a train and tracks as structured, and a complete set of ready-made trains and tracks as very structured. The Bank Street philosophy would suggest leaving as many options as possible for the child to create the train and track himself.

Q: What sorts of things are accomplished in having kids work with materials that are models of a larger realm, such as the neighborhood?

The six-year-olds at Bank Street used to make a model of some portion of New York City. They would spend a lot of time exploring the city outside in order to be able to create this model. The model usually included the subway, the pipes underneath the city, etc. That's one kind of modelling. Another version is mapping—a very abstract version. From these experiences, kids are not only learning facts, but relationships. They are learning about spatial relationships and how things interconnect; for example, where things come from beyond the grocery store.

Q: How important is it to make sure that kids have a tangible experience of the "real" world in relation to the models they create?

In the early years, ideally, experiences with building models were based on experienced reality. You have to get across the *idea* that different modes of representation exist before you can expect children to create different representations of what they're learning.

Q: What is the role of structure within the discovery-based classroom?

Most teachers have the structure in their heads. The rationale is in their heads. What becomes explicit and what stays implicit is a tricky issue. Sometimes it is important to make the structure explicit. How to do this without ruining the experience is hard. It has to do with the developmental level of the children and with aesthetics. A good teacher will know when and how to inject structure explicitly. If you are too explicit at first, you can kill the experience for some people.

Q: Is direct experience put at risk by electronically mediated experience?

My response to this question now, in 1989, is different from what it would have been in 1983. Now I would say that experience is experience, electronically mediated or not. Now I would ask, "What's it like?" but in 1983 I would have said, "Direct experience is experience and electronically mediated experience is not." The change in my thinking in the last six years has come about because of the appearance of more sophisticated software for children. I never knew you could do something like *Palenque*, for example. Seeing this was a learning experience for me. *Palenque* is multifaceted. You can learn about things in more than one way. It builds in more than one way of doing things. It presents different modes of representation and has a multitude of options. It doesn't have excessive, explicit structure like the early educational software did.

I believe that it's good to learn about things in more than one way. This holds for everything. What you do after the experience is also valuable. The more integrated learning experiences are, the better. Just sitting in front of a screen for extended time periods can be boring, just as sitting reading forever would be, or sitting making charts for a long time. Any of these activities could be seen as distancing or antisocial if done alone and for extended periods. The more varied and rich the learning experiences, the better. Anything in excess is a problem.

George Burns: The Classroom as Learning Environment

George Burns' classroom (8s/9s) is an excellent example of Bank Street's approach to building a successful learning environment. Walking into the room, it is hard not to feel immediately relaxed, comfortable, and stimulated. Animals of all kinds, a particular love of George's, inhabit cages throughout the room, on work tables and underneath the windows. The blackboard is mostly hidden beneath a large sheet of paper on which a mural is taking shape. Work tables are arranged in different-sized clusters, creating spaces that range from semi-private (near the wall, separated by an aquarium) to quite public (a large table near the door). An alcove set off from the main room has become a meeting area, with diminutive chairs forming a circle. Materials of all kinds—books, paper, art, supplies, work folders, a microcomputer—are spread out around the room within easy reach of the students.

The most striking feature of George's classroom is the independence and mobility that children have. Students decide where they want to work and move purposefully around the room, gathering materials they need, and discussing things together. Likewise, George himself is not anchored to a teacher's desk; he moves around the room working with individuals or small groups of students, and as he does so, others approach him with questions and problems. Our interviews were continually interrupted by questions such as, "Can I get a drink?" "George, do you have any more bookmarks?" "I need a pencil, George," and "Do you have any blue plasticene?" to which George might respond, "Check the shelf underneath the gerbils."

Multimedia, for George, means multiple materials and his emphasis is on what he calls the "collective process" of discovering what materials the class likes and will keep on hand—a matter of letting kids experiment with different materials in order to test their different expressive and also constructive possibilities. Multiple materials for George also means multiple sources of information. In using video in the classroom, for example, the thing he values most of all is its capacity to give students access to persons other than himself—people and perspectives that could not otherwise be presented.

The Interview

Q: What is life like for a teacher at the Bank Street School for Children?

For me, it's very stimulating, very tiring, and very rewarding. The most rewarding and fun part is interacting with the kids and engaging with their ideas, with what's going on in their heads. The difficult part is juggling all the different pieces of work going on at any one time—involvements with the Graduate School, the administration, the kids, their parents. Trying to talk to a lot of different people during the course of the day, and also remain close to the kids.

Q: How is your classroom and what goes on here different from most traditional classrooms?

One of the things that makes my classroom different is that the work we do tends to spring more from the interest of the kids themselves. We've set up structures in which kids are going to work, but the actual tasks kids are doing at any particular time tend to be more directly related to what interests them, the kinds of things they want to be doing. They're also more free to work in the manner they find most comfortable. I think that's one of the biggest differences—that the classroom acknowledges and respects the kids as individuals and tries to address them on that level. At the same time, the kids are more individually responsible for their work, and for themselves in relation to others.

Q: When you set out to design the classroom arrangement, what are the overall considerations you have in mind?

The guiding principle is that kids can work anywhere. The larger room is simply a mixture of table space, materials that kids use, and things that kids are going to have to be looking at or pieces of work that they're engaged in. The problem is that we have 26 kids in the room, often doing very different things at the same time, and this is not a big space. What I've done is separate the tables enough so that there are different areas you can work depending on whether you want to work alone, with others, or maybe in a small group. I've also tried to arrange certain pieces of furniture, like the animal cages, as dividers so that each space remains separate from the others. Kids sitting at one of these smaller tables will not be disturbed or disrupted by a larger group of kids working at the large table near the board. The challenge is to take the space and divide it up into areas that can be used in different ways simultaneously, and that can accommodate a whole variety of activities.

Q: It sounds like mobility is built into the environment—kids are free to interrupt what they're doing, to get up and move somewhere else, at almost any time. Are there limits to this kind of movement? How do you avoid pandemonium breaking out?

The only time problems occur is at the moments when the whole class is switching gears from one activity to another, and kids are trying to do one thing all at the same time. I try to regulate how the materials become available

to the kids, so they're not trying to get to their folders, for example, all at the same time.

Q: Do you give the kids any explicit introduction to the classroom and its organization in the beginning of the year?

We have a scavenger-hunt activity on the first day of class to introduce them to the space. I give them a list, which says things like, "Go find your cubby" or "Write down the name of one of the animals"—15 or 20 things that will allow them to move around a lot and find the different parts of the room. It also allows me to watch them and see how they interact.

Q: Do you have a personal sense of what it means to learn something?

It depends on the kid. Sometimes just the way a kid is able to suggest an idea at a meeting convinces me that important strides are being made. Or it might be in their writing, where they master something difficult I've suggested. Or simply getting excited about a book. For me there are lots of different indications that children are learning and developing skills.

Q: Just looking around the room I can see many different kinds of materials—art materials, books... What role does the availability of so many different media play in your teaching and in the kids' learning?

Each material has certain potentials that you have to discover. Plasticene, for example, has proven to be a very successful material with my kids. It's very pliable, but it can also take on very definite shapes. It's often used in art and social studies. When it sits on the shelf, nobody ever asks to use it because they tend to think it's for a specific type of activity. But if I say "During free time, you can use the plasticene," people will play around with it eagerly, for lots of different purposes—some expressive and some related to what they're working on. Lots of math materials are also this way. Every September, I try to put most of what's in my closets out in the classroom, and I encourage kids to see what they might want to do with a new material. If they don't come up with something productive, and if I can't think of anything, I just give it away. It's a collective process, discovering what materials we like and want to have around us.

Q: In the past you've taught Logo to both kids and teachers. How are you using the computer in your classroom now?

We use it for Logo-like programming games, and also for writing with the Bank Street Writer. We've also created a database of the different animals that we're studying. As far as technologies go, I think the greatest thing that teachers have wide access to is the VCR. It makes all kinds of materials available, because you can develop your own collection of very rich videos. Kids can actually see things that they may not get out of books. For me, even though I like having access to other media, the VCR has an immediate payoff—it makes available a huge range of materials that you can draw on as you need and want to. I don't have to plan at the beginning of the year for films that might not even be appropriate when they arrive.

Q: What for you are the main benefits of using video in the classroom?

The main advantage is that kids are able to see things that are otherwise difficult, if not impossible, to see. Pictures and books deliver vast amounts of information, but they don't always do so as vividly as video. And video often provides extra commentary. I especially like the fact that you can import other people to talk to the kids without actually having to go get that person.

Q: What might be an ideal use of interactive technology in your classroom?

Not long ago, we took a series of trips to the Central Park Zoo to study the animals there. The kids put together "guides" to the zoo complete with maps, descriptions of the animals, illustrations, and so on. I think it would have been great to use HyperCard or a similar program to help them make their guides interactive. The paper guides they produced were terrific, but compared with what they might have done with an interactive document, they were very static.

Q: How do you think the experience of making and using an interactive guide to the zoo would have been different from what they did?

I think the idea of being able to re-create a trip to the zoo would have been a lot of fun for the kids—drawing maps and keying them to pictures they've taken and descriptions they've written, so that by touching locations you can navigate around to different parts of the zoo. It would involve lots of sophisticated map skills and spatial logic. It would also be very compelling. They could try creating very simple kinds of graphics showing what each animal does—a bird could fly across the screen, for example. The kids are very proud of the paper guides they made; I think they would get even more involved with an interactive version they could keep adding to and that might offer something different each time they went back to it. They would probably return to it more often.

Q: Is it fairly routine for kids to draw from different sources of information—different people, different books—when they're working on a project or problem?

Yes. I see my role as directing the kids' inquiries. I try to discourage kids from seeing me as the primary source of

information. It's up to them to think about the questions they ask, and to want to have the answers. My role is to help them organize how they're going to go about answering the questions, based on their own ideas. Once they've gone and gathered information, we'll talk about it together. Sometimes I'll deliberately let a confusion or contradiction remain until they become aware of it themselves in our discussions. The only place where I give them information directly is sex education. Confusions there tend to wreak havoc if you let them go, not only in the kids' heads, but also at home!

Harriet Cuffaro: An Emphasis on Materials

An elaborate geometrical structure made of smooth rosewood blocks stands in the bookcase behind Harriet Cuffaro's desk. "It took me three hours to build that," she says. "The blocks are all triangles, and the constraints of building inside the bookcase forced me to think about how to do it for a long time."

Taking materials seriously is at the heart of Harriet's work at Bank Street College. As an instructor in the Graduate School of Education, she uses the investigation of young children's play with blocks as a cornerstone of her work with elementary teachers. Focusing on blocks is her way of helping teachers think creatively and critically about the roles that different materials can play in children's emotional and cognitive development.

Harriet's concentration on younger children (up to eight and nine years of age) means that the affective and social dimensions of learning are of great importance. For her, different media are tools for expression as well as thought, for the working through of relationships that are social as well as material and symbolic. In children's play with blocks, as she makes clear, all three modes of experience are at stake. Blocks provide, for example, natural vehicles for dramatic role playing as well as construction and mathematical reasoning. One of the questions that Harriet's work poses for those thinking about the design of electronic media is the degree to which wider considerations of social and emotional development—and the value of play itself—can and should be brought to bear in electronically-based materials designed for older students.

Among the qualities that make blocks powerful vehicles for children's learning, Harriet singles out their neutrality (their lack of specific qualities that dictate how and toward what end they are to be used) and, at the same time, their natural potential as materials for construction. Block play is an enterprise where goals evolve over time and remain subject to revision, one that invites children to invest something of themselves and their imaginations. The constructive possibilities of blocks often lead spontaneously to the building of models, particularly models of physical and social systems outside the classroom, thus inviting investigation of all kinds of relationships, both within the model and between the model and its outside "reality."

Translated into the domain of electronic media, these considerations might suggest approaches that move away from offering "delivery systems" in which the goals of the encounter are fixed by the nature of the material, toward offering more flexible tools with which children can become authors, constructing and testing their own interpretations of the material in question.

The Interview

Q: Do you have a particular vision of what learning is for the younger child?

My educational vision would have to include direct experience, the possibility of children using materials as tools and media for the expression of their ideas, their thoughts and feelings. And I think I would always include within this attention to the social. I see education as occurring in a social situation, and certain beliefs and commitments go along with this—a sense of responsibility for yourself, a sense of caring for others.

Q: What for you constitutes educational "success"?

For me a very fundamental criterion is whether a learning activity or encounter leads to further growth. What I look for, what I try to encourage, is continuity in learning, continuity in the sense that the person still is excited, curious, wants to learn, is motivated. Seeks challenge, rather than avoiding it. But all this would have to be understood in terms of each individual person, in terms of who he or she is. Because one person's excitement is different from another's. Some people mull, and they're terribly excited while they're mulling. Others are more visibly moved and you can tell right away. But not all experiences are educative; it's not growth in a vacuum I'm taking about. The questions are, in a sense, does it move you onward? Does it open up more vistas? Does it raise new questions? Do you make more connections within yourself? Learning is a conversation that you're having with the world. It's you and the world interacting.

Q: You say in one of your articles that a classroom "makes a statement." Could you explain that?

What teachers have to deal with are two basic philosophical questions: time and space. School goes on for a certain period of time and within a certain defined space. Your allocation of space and time in regard to different kinds of activities speak to what things are important to you, as a teacher and as a person.

Q: What are the most important things a teacher needs to think about in designing a classroom environment that promotes open-ended learning?

Flexibility and mobility are important qualities. A room where the desks are bolted to the floor says to the child, "Sit down, what you're going to be is a recipient." A room divided into different spaces with furniture and materials that can be moved around encourages experimentation, your ability to move around, your ability to make an impact. Another important feature is the kind of communication that can go on. You walk into a lot of classrooms and find chairs set up in rows, facing a podium. One of the things that does is curtail the possibility of communication among the students, because you face somebody's back. It also says we must direct our attention to the front. There's a basic asymmetry because the teacher is the only one capable of seeing everyone else. A room set up in a circle does several things. In part, it redistributes the environmental power of the previous set-up. The teacher becomes one of the circle.

Q: Are there other things that can make a classroom more of an experimental environment?

The most important elements are materials that don't dictate exactly how they should be used, but that allow lots of room for individual ways of handling them, on the part of the teacher and on the part of the kids. There also needs to be flexibility with regard to when particular activities begin and end, so that deep, sustained engagement with materials can be encouraged, and not be interrupted by intrusive, repetitive transitions to other activities. If you really want children to experiment, to discover, to make an impact, you don't say, "Please do it in the next fifteen minutes." You have to have flexibility in allocating a greater amount of time to an activity that's working, as opposed to one that's not, for whatever reason.

Q: What happens in young children's play?

I see play as the language of young children. It's the best means they have to express the complexity and the depth of their thoughts and feelings. It's a way of communicating to the outside world and themselves what they know, what they're feeling, what they're mulling over, what they're questioning.

Q: What happens specifically in block play?

What doesn't? It can be a material for the sole purpose of constructing, and this can take different forms. It can be for seeing how you make a statement in space. It can be an opportunity to synthesize or transform what you have experienced by recreating it. It can be so many things.

Q: How do blocks as materials help promote the kind of self-direction you think is important in learning?

Blocks, like all basic materials such as paints, clay, crayons, water, sand wood, and so on, don't come with recipe books on how to use them. Much of the school day can be filled with materials that are preprogrammed in one way or another. Like puzzles, they tell you what to do. There are seven pieces, you take them out, and then you put them back in. This cannot be compelling work, since there's very little real participation, very little investment of self. Now, blocks are for the most part mute. They don't tell you what to do. That means you have to meet the materials halfway. They invite you to invest something of yourself, your imagination.

Block building offers you choices all the time—choices of which block to use, where to place it in relation to others, what meaning or role to assign to what you've created. At the most fundamental level, the choice is yours to move in and out of whatever "reality" you've invested your creation with.

Q: Do you have any general thoughts or feelings about technology and its role in the education of young children?

My general feeling is that technology can be useful and appropriate as a tool, a tool to make more accessible things which might be inaccessible. It's a very valuable thing, for example, in special education. Children are able to do things that they otherwise wouldn't be able to do. And I think that word processing, for example, if it helps students to become more articulate instead of simply helping correct their spelling, is a wonderful application of technology to learning. But my question about young children's use of technology concerns what happens to direct experience. At a time when knowing is so intimately involved with using your senses, it's important that technology not replace direct experience. I think we begin to play with words when we say, in relation to a computer program, "The child will experience..." You don't experience. Experience is when you do it directly.

Q: Is it difficult to train teachers to adopt the kind of creative, experimental understanding that you have?

I think it requires a certain view of children. You have to be the kind of teacher who wants children to experiment, to explore, to ask questions. If children can ask questions, they can question your authority, and not everyone is

ready for that. And if you also believe that children can learn through their activity and through their play, you see that you don't need a lecture or a six-week unit on the postal carrier. This also means putting trust in children, being able to have faith in them. There's a lot that goes along with this.

Rosemarie Buzzio: Classroom Interactions that Promote Science Inquiry

As Math and Science Coordinator and teacher in the Bank Street School for Children, Rosemarie Buzzio stresses experimentation, and envisions the classroom as a laboratory in which children test the reliability of their ideas and representations of the world, including the things she tells them. Like Lucy Sprague Mitchell and John Dewey, Rosemarie recognizes that a "critical, ardent" spirit is cultivated as much in the way learning happens as in the actual material learned, that children learn from everything they do and from everyone with whom they come in contact. Therefore, experimentation in her classroom "laboratory" always proceeds in the context of thoughtfully varied human relationships.

The Interview

Q: What are your personal aims for teaching and helping others organize their science and math teaching?

My goal as a teacher and as a teacher's teacher is to get my students thinking, to get them to be curious, to ask questions. I'm not that concerned about factual information but more concerned about developing attitudes; for example, the attitude that the students should always be questioning. Approaches and attitudes need to be developed, whereas facts can be learned. With the children, I always want them to question what I do. They have the right to question me and the way you go about finding information. We have a debate coming up on creationism vs. evolutionism and I'm going to provide sources of information for them, but they have to go to the library and look at the sources themselves, and decide which are most important for their arguments. They're going to have to debate this themselves. I want my classes to become self-sufficient without me.

Q: In comparison to traditional science classes, how is what happens in your class different?

We don't have textbooks. Occasionally, we read articles or passages together and talk about them, but the classes are more based on experiences and the students' finding out things for themselves.

Q: What makes you feel that an activity has been successful with kids?

The last ten minutes. I've done activities where there is a lot of initial excitement, but that isn't success. Some people call an activity a success if it goes smoothly, if the kids get the right results, but I don't consider that a success either. I measure the success of an activity when the children are finished with the activity and discussing it at the end. The important part for me is when the synthesis has taken place, or the transition from the experience to the concept I wish to get across. If that doesn't happen, it isn't successful.

Q: Does the term "multimedia learning" have any particular association for you?

I usually think of slide projectors, movie screens...

Q: Could you sketch for us how you direct kids to sources and materials and how they draw from these different sources?

With the creationism vs. evolutionism debate, the kids were very excited when I mentioned the topic. By their excitement they sort of approved of the topic I selected. After that, I wrote up a direction sheet and asked them to find three articles from an outside library related to creationism or evolution and write the citation down. They write down the citation and put all of their articles into an article file. Some kids bring in relevant books, some have gotten newspaper and magazine articles. They will also talk to an expert on the subject. We might look at videotapes or films, like "Inherit the Wind." They divide themselves into two teams for their research work. The kids are able to proceed pretty much on their own by the time they are in the middle school because they have had experiences that are close to research in prior years.

Q: What will they be doing when they talk to the expert?

They'll ask questions we've already thought through, and keep notes on the interview.

Q: How does each group present its opinions?

I will help by designing questions for each group to answer, in order to get their thinking going. Since they can't do this completely on their own, I'll give them an outline. We'll have a rehearsal and then do the presentations in front of the other kids and parents.

Q: What do you do in the case where it's clear that one child within a group is having problems?

Two or three out of ten in a group are typically much weaker than the others. The less motivated, or weaker, ends up getting quite a bit out of the experience anyway. I've just kind of settled for that. We do group project work in math as well. They come to talk to me with problems. I encourage them to work through problems

within their groups. I don't like to solve kids' problems for them. In the end, my hope is that everyone will get something out of it.

Q: Do you use videotapes in your teaching?

With our discussions of human reproduction, video plays a key role. Also, for example, in earth science, natural disasters need to be shown on video.

Q: What does video uniquely allow to happen?

Video is especially good for visualization of what we've been talking about.

Q: Do you use computer software at all?

We use a lot of math software to supplement our curriculum. Things like Mathblaster, Algebra Arcade, and other drill-and-practice type things. We also use math software to strengthen certain concepts. For example, we use Green Globs and the Geometric Supposer. We have found less of a selection of interesting or appropriate software than you would expect...not much of the available software suits us. We also use spreadsheet programs and Appleworks in our own inventories of our work.

Q: Do you have any general or specific ideas about the role that these kinds of visual and computer media can play in learning math or science?

For science, visualization is very important. A firsthand look is most important, but some things can only be shown on video. In some cases, seeing the video helps to complete the picture. In terms of math, the materials we use are crucial because you need to have some model in front of you. Some kids need to work with the material for months. The software we use is supplementary. It plays a secondary role, but it can allow us to do more thinking than calculation—a spreadsheet facilitates that for you.

Q: If you could imagine a piece of software or video that you would really need, what might it be?

I would like to show word problems, especially for my algebra class—the logic behind thinking word problems through. I would want to show visual associations for each element of the problem; I think this makes a world of difference. Visualization of motion problems, especially, would be great. If you can associate an image with a problem, you can often maintain a much better grasp of it.

Kathy Wilson: A Multimedia Design Example

Kathy Wilson is the Multimedia Director for Bank Street College's Center for Children and Technology. She has designed and produced a number of multimedia applications, including *Palenque*, and has conducted formative and observational research into students, teachers, and learners of all ages using multimedia applications in a number of different learning environments. *Palenque* is a Digital Video Interactive (DVI) prototype for children that takes advantage of an electronically integrated, digitally stored, computer-controlled multimedia environment (Wilson, 1988). *Palenque* was developed collaboratively with GE/RCA's David Sarnoff Research Center from 1985 to 1987 and is currently under development as a museum product. At the core, *Palenque* is composed of a surrogate travel experience (the Explore mode) spatially organized, a multimedia database (the Museum mode) thematically/hierarchically organized, and a highly visual, intuitive interface. All of these have been complexly interwoven to provide an experience for children that allows them to get the feeling of exploring a photographically realistic ancient Maya site. While exploring, children can decide where they want to go on the site and what they want to pursue.

The Interview

Q: How do you define "multimedia"?

It's a term people are currently using to refer to a wide range of media environments. I used to think of multimedia as the fancy slide shows that corporations did when they were giving annual reports or sales talks—they'd have a couple of projectors with some nice dissolves between images, and maybe a great audio track. But there are lots of other interpretations. One model of a multimedia environment is the Bank Street program *The Voyage of the Mimi*, which is comprised of different media components—a television show, print materials, and computer programs—that are integrated thematically and in terms of the pedagogical approach, but are not integrated electronically. Another model involves kids using different existing technologies—video cameras, audio recorders, slide projectors—to make their own media products. That's multimedia too.

Then there's the model that involves integrating different media formats into one program. *Palenque* is an example of this. In *Palenque* we've incorporated slides, film, video, graphics, text, sound effects, and audio narration into one system, and integrated them together into an experience for children. From another perspective, you can see a preschool classroom as a multimedia environment, one that provides a rich assortment of sensory and cognitive stimuli. Taking an even wider view, I might say the world is multimedia—multisensory,

multidimensional, multirepresentational, etc. Multimedia combines the data manipulation that is possible with computers with the emotional impact, aesthetics, and appeal of realistic, dynamic images that are possible with video and film.

Q: Can you say where you think multimedia might begin to address the needs of teachers?

When I was a teacher, I used to think of myself as a sort of human octopus with lots of arms. This image had to to with the idea that it was really important for me to feel that I had something available at the end of each of these multiple arms so that if and when I needed them, I could grab the materials or activities that would be appropriate to a specific child for a specific learning need as it arose. In this way, I might be better able to maximize a spontaneous learning opportunity with a child or group of children. It seems to me that multimedia systems can offer an extra set of tentacles to teachers. They can help give teachers multiple inroads to a learning task and complement the multitude of other materials and activities already in place in classrooms.

Multimedia materials represent a synthesis of a variety of media formats currently available in our media-saturated culture. Children are quite familiar with these different media formats in the world outside the classroom, for better or for worse, through hours of television viewing and computer or videogame playing. The typical classroom, in contrast to the typical home, is media-impoverished. Most homes these days have a television set, a telephone, a VCR, and a stereo of some kind. Children are very familiar with these things and use them quite competently at home for information, communication, and entertainment. Multimedia materials, which introduce components of these consumer technologies into the classroom, can help to bridge the "media gap" between classrooms and the world outside them. Electronic multimedia materials have the potential to open the door to learning for children who might otherwise be turned off by the way things are traditionally presented at school, by motivating them through appealing, multisensory information delivery and learning experiences in a medium and style with which they are familiar. As far as I can tell, people don't learn things or become engaged with things until they are motivated and curious, until they have some interest in them.

Q: Does the individual medium—for example, video, computers, or text—have particular, unique strengths that become combined in a multimedia system?

We interviewed children about this question at one point—the particular strengths and weaknesses of several media. They had a lot of ideas about this. For example, they suggested that a book might give more details, might involve a carefully developed story, might lead a reader to imagine his own images and sounds, might portray a particular point of view. In addition, books are tangible and portable, you can jump around at will in a book while reading, or decide when to stop and start reading. You have time to put the book down and reflect on it. In other words, you have some control over your use of a book—where, when, how. A television show or film might show things and let you hear things in a more "real," experiential way than a book, almost as if you were there, with lots of visual and auditory richness. They also can contain stories and points of view. With VCRs and multiple broadcast or cable channels, we now have limited control over the what, when, and how with video. A computer, depending on the the way you are using it, can allow users to take an active role through the manipulation of information in new ways. It is often seen as a tool more than a prepared presentation, like a book or film. For example, the text editing and drafting capabilities made possible with word processors and the number manipulation made possible with spreadsheet programs are seen as strengths unique to computers.

Q: How can a well-designed multimedia environment help promote successful learning environments?

The key word is "well-designed." Multimedia per se is like anything per se. In this case, it is just a technology that can be used in any number of ways for any number of reasons and users. If multimedia applications for education are done quickly or without much thought to learners, learning goals, and learning contexts, then it is not likely that they will be very useful in the learning process. But, at least at this point in time and for a long time ahead, even the most well-designed multimedia environment can't let the child know it cares for them or is interested in their progress. It can never be a substitute for a talented, compassionate teacher.

Q: Are there any general ways that electronic multimedia environments differ from nonelectronic ones?

Well, some studies suggest that extended use of computer monitors may not be good for children's eyes, or health, for that matter. There's one difference. Right now, electronic multimedia environments are missing a sense of tangibility, a 3D, multidimensional, hands-on sense (although experiments at places like NASA with telepresence and simulated 3D worlds may change this). Electronic multimedia environments are also missing a sort of portability and "reality" (whatever that is anymore, I'm not sure). I feel this way about everything from computer software and videotapes to interactive video and multimedia applications. There's something ethereal about them. You pull the plug or flick the switch and they're gone; you can't take home a little Maya temple from the screen. They involve a moment-to-moment experience that goes away; you can relive it, but it's not

as though you can take home the little (simulated) clay figure that you've been working on all afternoon on the monitor and show your mom. At least not yet.

Q: Many multimedia applications seem somewhat superficial in their treatment of material. Do they tend, as a rule, to sacrifice depth for breadth?

Well, I'm not sure. Part of what we are seeing now are many, many multimedia prototypes that are demonstrations of hardware more than anything else, and for hardware, demos content development is rarely the major concern. It is true that there are some multimedia projects out there that make you wonder who did the content research and how correct it is. This is particularly true for multimedia databases that are targeted for the educational market. Here, accuracy is important. There needs to be a certain amount of rigor and some way of feeling confident that the database is accurate, or at least that it represents the opinion of the time as we know it.

Bill Tally: Formative Research with Multimedia

Bill Tally has conducted formative research at the Center for Children and Technology for more than five years, and has helped design educational software and interactive video material for both *The Voyage of the Mimi* and The Palenque Project. In the interview that follows, he discusses the role of research with children in the development of educational media at the Center. In keeping with the child-centered approach to education at Bank Street, formative research gives children a crucial role in the development of the materials that will find their way into classrooms and homes.

The Interview

Q: How would you describe the formative research that you've been involved in at Bank Street?

Basically, the formative research efforts at Bank Street involve going out and collecting the opinions and expertise of others and feeding them into the process of designing and developing educational materials and experiences for kids. In method, formative research bears a lot of resemblance to market research: Both entail interviewing very small numbers of users about a product under development, in order to see how a much larger group of people will use it, and whether they will like it; in both, the feedback you provide to designers and producers helps them make the product more comprehensible and appealing to the target audience.

Where formative research differs from market research is in the attempt to evaluate the educational soundness of the materials. We try to consider not just questions of appeal, but also age appropriateness, the quality of the interaction with the materials, and the kinds of understandings that kids take away from these interactions. Toward this end, we've evolved a loosely ethnographic approach, where we try to observe kids using the materials in as relaxed a setting as possible, taking notes, and sometimes videotaping what happens in the classroom or lab. Usually we work with at least two kids at a time, because in talking with each other they externalize their thinking.

One thing that formative research represents, in whatever form it exists, is the willingness to let end users have a go at a product or prototype under development, to let them do with it what they will. It's saying that the end users, in this case kids, are important. In a way, this requires that designers, producers, and programmers give up a measure of control. Many of your most brilliant insights and elegant designs are liable to be out the window once you see what kids do with them, because you can't predict the way that kids are going to react.

Q: Who would you say benefits most from formative research?

The most immediate audience that the research exists for are the developers of the materials. It plays its best role when there's a close relationship between developers and researchers. In the Palenque Project, there was a great deal of overlap between the people doing the design and the people doing the formative research; in fact they were often the same people. In some circumstances this might be considered "contamination" of the research, but for me it led to a very clear sense that the research was making a difference. As designer-researchers we saw exactly what did and didn't work for the kids, knew what revisions needed to be made, and were able to communicate these to the programmers directly. There was not much bulky report writing, but rather a lot of direct and relatively immediate discussions between the designer-researchers and the programmers.

Q: In watching kids interact with the different media, say television versus computer software versus interactive video, are there differences in terms of the direction your formative research takes?

In the lab setting, at least, you're looking for different things in each of the different media. With television, which is noninteractive, we first watch for signs of interest or boredom while kids are viewing the program. Then, in small group discussions after the program, we try to determine what ideas, information, attitudes, and confusions kids have taken away from the experience. As a stimulus, we might show them a segment with the sound off and have them narrate what they think is going on, or talk about their reactions. The particular questions we ask will vary depending on the format and aims of the

materials. With a dramatic series like *The Voyage of the Mimi*, where kids' immediate emotional involvement with the characters and story is important as the "hook" that will motivate their later intellectual inquires in the classroom, we want to know several things. Do kids understand the basic storyline, and do they find it and the theme appealing? Do they identify with particular characters, and do the key story events have an emotional impact on them? Are they curious about the human and scientific problems the drama poses, so that they want to know more? With a documentary format, like the one presented by the *Mimi* Expeditions, our questions have tended to focus more on kids' comprehension of whatever content is presented, as well as their perceptions of scientists and scientific work, a special concern of the *Mimi*.

With computer software, our attention is focused more on the kinds of interaction kids are having with the program while it is under way. Is the screen display readable and are the material accessible to the children? Do kids master the interface conventions easily, concentrating on the content of the program instead of some extraneous detail? Often the feedback we supply to designers and programmers is quite specific—we can say exactly which screen display left kids confused and what kinds of prompts might clear up the confusion. Ultimately, the questions we ask of a computer program are the same as those we ask of television: Does it yield a coherent experience in which kids absorb new knowledge, make new connections, and expand their curiosities?

With multimedia applications that include video, these approaches are combined and the kinds of questions we ask multiply. We may be concerned about the dramatic impact of characters and setting, and we are always concerned about children's ability to manipulate the interface. Also, since these systems' capacity to combine video images, sound, graphics, and text are constantly evolving with each new application, we are very interested in children's ways of comprehending the often striking results. With *Palenque*, for example, the questions included whether the "surrogate travel" effect was convincing: Did children experience themselves as "walking through" an actual Maya site in Mexico? How did they distinguish between those parts of the experience that involved aspects of "fantasy" and those based in "reality"? In *Palenque*, we were trying to stimulate kids' curiosity and get them to explore deeply and ask questions about the Maya, based on the things they encountered in the application. I think the important thing is, if you're not trying to convey a certain skill, if you're talking about an open-ended environment in which kids are partly the authors of the experience, interpretation plays a large role. If you admit that interpretation is involved, you're saying the person's own meaning matters and that there will be different meanings for different users. As a researcher, you need to be sensitive to a wider range of variables. You need to take account of how different people are gesturing, acting, and speaking while exploring these multimedia environments. The formative researcher is almost a diagnostic interviewer and ethnographer who lets things happen and encourages a conversation between the user and the system.

Q: What kinds of things have you learned as a formative researcher working in classrooms, as opposed to the laboratory?

When we began to test the *Mimi* in classrooms instead of in the lab environment, I immediately discovered that the factor of the teacher was big and had to be grappled with. You had to convince teachers of the value of the materials in order for things to happen with the kids. This factor of the teacher, along with the the constraints and complexities of the particular classroom and school structure, introduced a whole set of variables which the *Mimi*, for all of its thoughtfulness, only began to address.

When we went into classrooms with videodiscs, likewise, all of the contradictions involved with educational research and development became starkly apparent to me. By this, I mean the distance between research and practice, and the fact that the solutions so carefully reasoned out and so elegantly designed in the heads of researchers and designers often do not address the most basic obstacles confronting teachers and kids in most school classrooms. It's taken me and a lot of educational researchers a while to recognize the gap that exists between what we believe to be the potential role of new technologies in a transformation of educational practice, and the reality of the somewhat meager role they have actually played so far.

Sam Gibbon: Multimedia in the Classroom

Building up vivid and satisfying images of the world and giving children the tools with which to discover the relationships inherent in them is what Sam Gibbon's work on *The Voyage of the Mimi* is all about. These innovative educational materials combine the strengths of three different media—television, computer, and print—to give teachers and children a wide array of opportunities for investigation into science and mathematics at the upper-elementary level.

At the core of the materials is a television narrative that stimulates the interests of students by importing into the classroom some exciting pieces of the real world (whales, Maya ruins), and relating the adventures of an attractive group of young scientists who

are studying them while aboard the floating laboratory, the Mimi. Accompanying documentaries introduce students to the work of real scientists and develop themes suggested in the dramatic episodes. Individual learning modules, each featuring both computer and noncomputer activities, allow students to delve further into the topics they have become interested in through the television series: whales and their environment; ecosystems; maps and navigation; and the number system of the ancient Maya. Importantly, each of the computer activities models a particular adult use of computers, such as programming, data collection, and simulation. Thus, writes Sam, "while working with these programs, children are becoming familiar with some of the many ways computer technology is reshaping the ways in which we understand our world and represent it to ourselves" (Gibbon, 1986)

In the interview that follows, Sam reflects on some of the thinking that lay behind the development of these materials, and on what has been learned from their use by teachers and students in classrooms.

The Interview

Q: How are you currently describing The Voyage of the Mimi?

It's a multimedia, multidisciplinary effort funded by the federal government to teach science, math, and whatever else comes along, to late elementary school kids. We are being more and more frank about the intention to integrate the curriculum around the *Mimi*.

Q: Can you describe the vision that lies behind the Mimi? *What are its aims, and what sorts of assumptions about children's needs and capacities does it rest on and try to address?*

Speaking for myself, and not for all of the people who, in fact, did design the materials, my own personal interest in the *Mimi* starts from a very self-centered feeling that curiosity is the most useful educational impulse. This is so obvious it's almost embarrassing to point out, but curiosity is what makes people want to learn about things; there's nothing else that works as well. We are coming around now to a more interdisciplinary conception of the *Mimi* as not just a science and math program, but one that might also involve history and literature as well. What is so nice about this approach is that you don't have to observe any of the usual disciplinary boundaries. You can be curious about anything and, in fact, satisfying one curiosity tends to create others. Whoever the great dean in the sky was who decided where metaphysics ends and physics begins doesn't control what happens in a child's head. Curiosity can go anywhere.

Q: Can you say more about deep versus broad understanding?

The virtues of deep understanding of anything are much greater than they first appear. They give the kid the experience of having ferreted out information for herself, and the confidence that comes from that: the knowledge that you can be an expert, the desire to satisfy the next curiosity that comes along, etc. It makes a child a self-motivated learner to have had the experience of acquiring a deep understanding of something.

Q: How can we use media to promote in-depth learning?

I can tell you a couple of ways the *Mimi* tried to encourage it. First, there is this notion of starting from children's interests. Whales were known from our research with children at the Children's Television Workshop to be interesting to kids, and this was true across racial, gender, and socioeconomic categories. Now, you can look at whales as biological animals, as economic creatures, as physical entities, and as missiles that have to move through a fluid. In fact, the number of ways in which, once you're interested in whales, you can think about whales is infinite and crosses all curriculum boundaries. If you wanted to, you could get to any little piece of anybody's curriculum starting from whales. If it's a good topic, then what you want to do is effectively engage kids with whales. Well, most kids can't touch them, they can't smell them, they can't hear them. But you can give them as close-up a look in video as you possibly can. That's a pretty good approximation of being near whales. It certainly seems to create the desire to get closer to them in the flesh. And I suspect that's true of anything. You watch anything that grabs you on television and you'd like to be there.

Another aspect of it is that kids like stories. They lose themselves in stories. It's hard to lose yourself in something that you have to think about, because you're constantly thinking about yourself thinking about it. And you're constantly weighing the information-processing effort that you have to put in at any given moment. You can't really forget about yourself when you're watching an information documentary or a news show; it's just impossible. But you can very easily forget about yourself in a good story.

Now, if you've got a good, involving story about whales, and you know that the kid is going to forget about him- or herself, you can twist the kid in lots of different ways. You can show scientists that look a little attractive. You can show kids developing competencies and all the things you know the audience wants, and you can create a desire to be like that in the kids. There are a million targets of opportunity in the show, and the question is only which ones you want to amplify.

Q: Can you tell us your thoughts about discovery-based learning?

This whole notion of discovery learning is short-circuited when the things to be discovered are assigned. And the kids see right through it when that's the case. Discovery happens in a kind of haphazard way. It's only fun and exciting and motivating to do more discovery if no one has foreseen it, if the opportunity hasn't been arranged for you. This is just elaborating on the danger of too much planning. "Planned discovery" is almost an oxymoron.

Two other things: One is the desire kids have to be competent, to be able to do things. It becomes enormously strong in boys, but not only in boys, I think in all kids, around seven or eight and probably continuing through adolescence. It's such a powerful motive, you wonder why we haven't found ways to use it. It seems a perfect match-up for education, a perfect opportunity, and yet it seems almost as if schools frustrate that need to be competent. You're required to be incompetent for much longer than is natural for people to be incompetent.

Q: Do you think kids have changed over the years since the appearance of electronic media?

I don't know. Kids certainly are thinking about things that are vastly different from what I was thinking about as a kid. I think it's absolutely true that as the variety of experiences that are available to kids increases, as the number of sensory stimulants and their variety proliferates, we evolve culturally. But I don't really think the organism changes all that much.

What this means for me is that we're able, because there is a demand for it, to present visual experiences that are closer and closer to the experiences we have walking around in the world. Where the definition of my visual information right now is a thousand or a million times that of high definition TV, we'll have systems that will approximate vision and will be surrounding my head 360 degrees. I'll really feel like I'm walking around the park. I think that's the direction we're moving. But, we haven't even come close to making the ultimate interface. We're still working on it.

So, I don't think there is any change in the organism that is interfacing with technology. There is certainly change in technology, and that results in making lifelike experiences available that aren't viridical—they aren't life, but they feel more and more like life. And who knows what the effect of that is.

Q: Do these increasingly mediated electronic experiences put at risk the notion of "direct experience" that Bank Street pedagogy traditionally esteems? Should they be embraced or braced against?

I think you have to do both things. You have to use the better and better, finer and finer matched interface for carefully examined purposes. But then, you also have to say occasionally, "Go touch something, don't just look at things. Go talk and don't just listen. Go make something instead of appreciating what other people have made." It becomes more and more important to get kids in touch with the real world. Of course, it's harder and harder to find that, and it's also more and more reasonable to wonder if there is such a thing.

Q: What is your idea of a successful Mimi *experience?*

The success story I hope is out there and I know is out there in bits and pieces is a place where everybody looks at the television show and the software, and they get excited about it.

It seems to me that what develops in the classroom then is a kind of community, where kids and teachers become collaborators in learning. And because they're collaborators, the kids have more responsibility for their own learning, and teachers recognize that, and allow it, and rejoice in it, and things go ahead from there. One of the beneficial side effects of this is that the teachers have to make it clear that none of them knows everything. There also can be occasional models where some people know surprising things outside of what you thought was their discipline. You can have these occasional moments where people are not seen as compartmentalized. This necessarily involves more fully-dimensional, human, and adult intellectual models for kids to emulate. And further, I think it allows the pursuit of idiosyncratic curiosities within the classroom. A community that undertakes this kind of joint learning experience distributes its learning around the community, and individuals are not only permitted, they're really required, to do their share in the group learning.

Not long ago we got a letter from a 13-year-old girl. She used a little drawn heart to mean "I love." She hearted everything. She hearted the *Mimi I*, she hearted the *Mimi II*, she hearted Ben Affleck (who plays CT) most of all. She said, "I wish you could make more voyages. Perhaps you could call the next one "The Third Voyage of the Mimi." Well, I wonder exactly what it means to "heart" the *Mimi*. You'd like to think that what she meant was she'd hearted a whole lot of learning experiences that looked traditionally curricular—she hearted latitude and longitude, she hearted food chains, etc. I'm not sure that's the case, but I really believe that once you've "hearted" something, it's a lot easier to "brain" it.

SUMMARY

Through the interviews and discussions in this paper, we have begun to describe the range of multimedia learning environments and materials that have been developed at Bank Street College over the past seventy-five years, both nonelec-

tronic and, more recently, electronic. We have a hunch that designers of electronic multimedia learning environments can learn a lot from these nonelectronic practices and materials, and might even find ways to incorporate some of their features into educational products in the future.

What follows is a simplified list of some of the features that appear throughout the interviews to be common to most of Bank Street's discovery-based multimedia learning environments for children:

Characteristics of the Learning Experience

1. **Child-centered.** An attempt is made to start where the children are in terms of their capabilities and interests and to build from there. Self-direction and exploration based on each child's curiosity is encouraged. This self-motivated learning is not "free form" but guided by the implicit structure of the classroom, materials, activities, and/or teacher.

2. **Direct experience and "real-world" connections.** Attempts are made to bring the real world into the learning environment (e.g., through video, visitors, materials) and to extend the activities of the learning environment into the outside world (e.g., through field trips, explorations of the neighborhood) The children are encouraged to see the connections between what and how they are learning in the classroom and the larger world around them, and to begin to extrapolate from the particular to the general.

3. **Interaction.** Learning is characterized by interaction on many levels, including children interacting with each other, children interacting with the teacher, children interacting with various materials, and children interacting with the world outside the classroom.

4. **Analysis and action.** Children are encouraged to learn through doing: asking questions, constructing, exploring, researching and manipulating objects and processes. Learning is active, experiential, analytical, expressive, and collaborative. Children become observers, investigators, researchers, producers. They are encouraged to question things and people around them and to be constructively critical. They work together to solve problems, discuss them, and work toward possible solutions.

5. **Engagement.** Active and deep engagement with learning tasks is encouraged. This involves time- and resource-intensive activities that allow children to pursue individual interests deeply, rather than quickly or efficiently. Emphasis is on activities that are meaningful to children and allow them to use what they are learning, but that are also appealing and fun. Children are encouraged to become personally invested in their learning and to develop a self-image of competence.

6. **Collaboration.** Children are encouraged to work with others (peers, teachers, other adults, parents, siblings) to solve problems and accomplish tasks. The teacher is thus one of many people in the learning environment to whom the child can turn to work through problems.

7. **Interdisciplinary.** Learning activities are designed to be multidisciplinary and interdisciplinary. Various traditional curriculum areas are integrated through theme-based activities. Connections between traditional disciplines and learning to see and make relationships are emphasized.

Characteristics of the Learning Environment

1. **Classroom as laboratory.** An attempt is made to create a learning environment in which the discovery of relationships can occur. Within this lab- or studio-like environment, children are encouraged to observe, explore, and experiment; to relive their first-hand experiences in the world through the manipulation of materials and the use of tools; to come to their own understandings of things and the relationships between things.

2. **Organization: spatial and temporal.** The organization of the learning environment allows children to experience freedom of movement and exploration within a sense of structure. For example, the organization of the learning space into discrete activity areas (discussion areas, small group areas, individual reading and writing areas) provides one sort of spatial structure. The organization of the day into time frames for different activities and the sequenced introduction of activities and materials throughout the year provide different kinds of temporal structures.

3. **Flexibility and consistency.** An attempt is made to make the structure of the learning environment flexible enough to allow for changes that can take advantage of spontaneous learning opportunities and needs as they occur, but also consistent enough that children do not become confused or anxious about the relative "fluidity" of the environment.

4. **Resource rich.** An attempt is made to create a learning environment that is multidimensional and multisensory. Such an environment has an array of materials and activities and offers children a variety of

ways to approach any given task. Through this richness, children can begin to see things from a number of points of view and learn things through multiple representations as well as through a variety of modalities (visual, auditory, tactile).

5. **Humanness**. The human element is very important in these learning environments. People are seen as a crucial ingredient in the learning process in any of a number of roles, including teachers, guides, coaches, experts, fellow learners, students, models, companions.

Related Articles

Ambron, S., & Hooper, K. (1988). *Interactive multimedia: Visions of multimedia for developers, educators, and information providers*. Redmond, WA: Microsoft Press.

Ambron, S ., & Hooper, K. (1990). *Learning with interactive multimedia: Developing and using multimedia tools in education*. Redmond, WA: Microsoft Press.

Antler, J. (1987). *Lucy Sprague Mitchell: The making of a modern woman*. New Haven: Yale University Press.

Bennion, J. L., & Schneider, E. W. (1975). Interactive videodisc systems for education. *Journal of the Society of Motion Picture and Television Engineers, 84*(12), 949-953.

Biber, B. (1954). *Early education and psychological development*. New Haven: Yale University Press.

Bolt, R. A. (1984). *The human interface: Where people and computers meet*. Belmont, CA: Lifetime Learning Publications.

Brand, S. (1987). *The Media Lab: Inventing the future at MIT*. New York: Viking Penguin.

Bransford, J. (1985). *Computers, videodiscs, and the teaching of thinking*. Paper presented at the National Association of Science Conference.

Bransford, J., Sherwood, R., Vye, N., & Reiser, J. (1986). Teaching thinking and problem solving: Research foundations. *American Psychologist, 14*(10), 1078-1089.

Brown, J. S. (1986). From cognitive to social ergonomics and beyond. In D. A. Norman & S. W. Draper (Eds.), *User-centered system design*. Hillsdale, NJ: Erlbaum.

Brown, J. S. (1983). Learning-by-doing revisited for electronic learning environments. In M. A. White (Ed.), *The future of electronic learning*. Hillsdale, NJ: Erlbaum.

Brown, L. K. (1986). *Taking advantage of media: A manual for parents and teachers*. Boston, MA: Routledge & Kegan Paul.

Bruner, J. S. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.

Bruner, J. S. (1961). *After John Dewey, what?* New York: Bank Street College of Education Publications, #54.

Bruner, J. S. (1985, June/July). Models of the learner. *Educational Researcher*, 5-8.

Bruner, J. S. (1977). *The process of education*. Cambridge, MA: Harvard University Press.

Bruner, J. S. (1982). *Toward a theory of instruction*. Cambridge, MA: Belknap.

Char, C., & Tally, W. (1986). *Getting the picture: Four classroom case studies of videodisc use in schools*. New York: Bank Street College of Education, Center for Children and Technology.

Chen, M., & Paisley, W. (1985). *Children and microcomputers*. Beverly Hills, CA: Sage.

Coburn, P., Kelman, P., Roberts, N., Snyder, T., Watt, D., & Weiner, C. (1982). *Practical guide to computers in education*. Reading, MA: Addison-Wesley.

Collins, A., Hawkins, J., & Carver, S. (1991). *A cognitive apprenticeship for disadvantaged students*. New York: Bank Street College of Education, Center for Technology in Education.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920*. New York: Teachers College Press.

Cuffaro, H. (1984). Dramatic play: The experience of block building. In E. S. Hirsch (Ed.), *The block book*. Washington, DC: National Association for the Education of Young Children.

DeBloois, M. L. (1982). *Videodisc/microcomputer courseware design*. Englewood Cliffs, NJ: Educational Technology Publications .

Dewey, J. (1938). *Experience and education*. New York: Collier.

Dewey, J. (1965). *The child and the curriculum, the school and the society*. Chicago: Chicago University Press.

Floyd. S., & Floyd, B. (1982). *Handbook of interactive video*. White Plains, NY: Knowledge Industry Publications.

Franklin, C., & Kinnel, S. K. (1990). *Hypertext/hypermedia in schools: A resource book*. Santa Barbara, CA: ABC-CLIO.

Gagne, R. M. (1982, June). Developments in learning psychology: Implications for instructional design. *Educational Technology*, 11-15.

Garvey, C. (1977). *Play*. Cambridge, MA: Harvard University Press.

Gayeski, D., & Williams, D. (1985). *Interactive media*. Englewood Cliffs, NJ: Prentice-Hall.

Gibbon, S. Jr. (1983). The electronic learning environment of the future. In M.A. White (Ed.), *The future of electronic learning*. Hillsdale, NJ: Erlbaum.

Ginsburg, H., & Opper, S. (1969). *Piaget's theory of intellectual development: An introduction*. Englewood Cliffs, NJ: Prentice-Hall.

Greenberger, M. (1990). *On multimedia*. Santa Monica, CA: The Voyager Company.

Gruber, H. E., & Voneche, J. J (1977). *The essential Piaget: An interpretive reference and guide*. New York: Basic Books.

Harel, I. (Ed.). (1990). *Constructionist learning*. Cambridge, MA: MIT Media Laboratory.

Hirsch, E. S. (Ed.). (1984). *The block book*. Washington, DC: National Association for the Education of Young Children.

Hodgkin, R. *A. (1985). Playing and exploring: Education through the discovery of order*. London: Metheun.

Holt, J. (1967). *How children learn*. New York: Dell.

Howe, M. J. A. (1983). *Learning from television: Psychological and educational research*. London: Academic Press.

Iuppa, N. V. (1984). *A practical guide to interactive video design*. White Plains, NY: Knowledge Industry Publications.

Lambert, S., & Sallis, J. (Eds.). (1987). *CD-I and interactive videodisc technology*. Indianapolis, IN: Howard W. Sams.

Lambert, S., & Ropiequet, S. (Eds.). (1986). *CDROM: The new papyrus*. Redmond, WA: Microsoft Press.

Laurel, B . (Ed.). (1990). *The art of human-computer interface design*. Reading, MA: Addison-Wesley.

Luther, A. C. (1989). *Digital video in the PC environment*. New York: Intertext Publications.

Martin, L. (1986). *Teachers' adoption of multimedia technologies for science and mathematics instruction*. New York: Bank Street College of Education, Center for Children and Technology.

Mitchell, L. S. (1950). *Our children and our schools*. New York: Charles Scribner's Sons.

Mitchell, L. S. (1934). *Young geographers: How they explore the world and how they map the world*. New York: John Day.

Nelson, T. H. (1987). *Computer lib, dream machines*. Redmond, WA: Tempus.

Nickerson, R. S. (1986). *Using computers: Human factors in information systems*. Cambridge, MA: MIT Press.

Norman, D. A. (1982). *Learning and memory*. New York: W. H. Freeman.

Norman, D. A., & Draper, S. W. (Eds.). (1986). *User-centered system design*. Hillsdale, NJ: Erlbaum.

Olson, D. R. (Ed.). (1974). *Media and symbols: The forms of expression, communication, and education*. Chicago: University of Chicago Press.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books.

Parsloe, E. (1983). *Interactive video*. Bristol: J. W. Arrowsmith.

Philips International. (Ed.). (1988). *Compact disc interactive: A designer's overview*. New York: McGraw-Hill.

Piaget, J., & Inhelder, B. (1969). *The psychology of the child*. New York: Basic Books.

Rheingold, H. (1985). *Tools for thought*. New York: Simon & Schuster.

Ropiequet, S., Einberger, J., & Zoelick, B. (Eds.). (1987). *CD-ROM: Optical publishing*. Redmond, WA: Microsoft Press.

Roberts, L. G. (Ed.). (1989). *Linking for learning: A new course for education*. Washington, DC: U.S. Congress, Office of Technology Assessment.

Roberts, L. G. (Ed.). (1988). *Power on! New tools for teaching and learning*. Washington, DC: U.S. Congress, Office of Technology Assessment.

Rowntree, D. (1982). *Educational technology in curriculum development*. London: Butler & Tanner.

Salomon, G. (1989). *Interaction of media, cognition, and learning*. San Francisco, CA: Jossey-Bass.

Schneider, E. W., & Bennion, J. L. (1981). *Videodiscs*. Englewood Cliffs, NJ: Educational Technology Publications.

Schwartz, J. L. (1983). Tyranny, discipline, freedom, and license: Some thoughts on educational ideology and computers. In WNET (Eds), *Education in the electronic age: Report from the Learning Lab*. New York: WNET.

Shapiro, E., & Biber, B. (1972). The education of young children: A developmental-interaction approach. *Teachers College Record, 74*(1).

Sheingold, K., & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice*. New York: Bank Street College of Education, Center for Technology in Education.

Sheingold, K., & Tucker, M. (1990). *Restructuring for learning with technology*. New York: Bank Street College of Education, Center for Technology in Education with the National Center for Education and the Economy.

Shulman, L. S., & Keilsar, E. R. (Eds.). (1966). *Learning by discovery: A critical appraisal*. Chicago: Rand McNally.

Skinner, B. F. (1954). The science of learning and the art of teaching. In M. D. Gall & B. A. Ward (Eds.). (1974). *Critical Issues in educational psychology*. Boston: Little, Brown.

Sleeman, D., & Brown, J. S. (Eds.). (1982). *Intelligent tutoring systems*. London: Academic Press.

Snyder, T., & Palmer, J. (1986). *In search of the most amazing thing: Children, education, and computer*. Reading, MA: Addison-Wesley.

Tally, W., & Char, C. (1987). *Children's use of the unique features of interactive videodiscs*. New York: Bank Street College of Education, Center for Children and Technology.

Taylor, R. (Ed.). (1980). *The computer in the school: Tutor, tool, tutee*. New York: Teachers College Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Walker, D. F., & Hess, R. D. (1984). *Instructional software: Principles and perspectives for design and use*. Belmont, CA: Wadsworth.

Wilkinson, A. C. (Ed.). (1983). *Classroom computers and cognitive science*. New York: Academic Press.

Wilson, K. (1988). Palenque: An interactive multimedia digital video interactive prototype for children. *Conference Proceedings*, Conference on Human Factors in Computing Systems, ACM/SIGCHI and ACM/SIGGRAPH, Washington, DC.

Wilson, K. (1991). The interactive video research and development project of the Museum Education Consortium. *Visual Resouces, II*, 395-400.

Wilson, K. (1988). *The Palenque design: Children's discovery learning experiences in an interactive multimedia environment*. Doctoral dissertation, Harvard University, Graduate School of Education, Department of Human Development and Psychology.

Wilson, K. (1985). "The Voyage of the Mimi" prototype videodisc. *Bulletin of Science. Technology and Society, 6*(3 & 4), 321-323.

Wilson, K. (1989, Spring). Through the multimedia looking glass. *Apple Education News*, 14-16.

Wilson, K. S., Brunner, C., Hawkins, J., & Webster, K. (1987). *A design scrapbook of discovery experiences in multidimensional worlds*. HyperCard Project for Apple Computer, Inc. New York: Bank Street College of Education, Center for Children and Technology.

Wilson, K. S., & Hawkins, J. (1987, April) *Designing for inquiry: Exploring roles for technology*. Paper presented at the annual meeting of the American Educational Research Association, Washington, DC.

Wilson, K., & Tally, W. (1991). *Classroom integration of interactive multimedia: A case study*. New York: Bank Street College of Education, Center for Technology in Education.

Wilson, K., & Tally, W. (1991). *Looking at multimedia: Design issues in several discovery-oriented programs*. New York: Bank Street College of Education, Center for Technology in Education.

Wilson, K., & Tally, W. (1990). The Palenque project: For native evaluation in the design and development of an optical disc prototype. In B. Flagg (Ed.), *Formative evaluation for educational technologies* (pp. 83-98). Hillsdale, NJ: Erlbaum.

Winograd, T., & Flores, F. (1987). *Understanding computers and cognition*. Reading, MA: Addison-Wesley.